

Section II. REMARKS

Rewriting of Prospectively Allowable Claim 27 in Independent Form

In the May 19, 2003 Office Action, claim 27 was objected to as being dependent on a rejected base claim, but indicated as "allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims" (page 8 of Office Action).

In response, claim 27 has been rewritten in independent form. It therefore is requested that claim 27 be formally allowed.

Rejection of Claims on Reference Grounds, and Traversal Thereof

In the May 19, 2003 Office Action, claims 1-26 and 28-39 were rejected on reference grounds, including:

a rejection of claims 1-8, 11-12, 14 and 16-17 under 35 U.S.C. §102(c) as anticipated by Tsu et al. USP 6,294,420 (hereafter "Tsu");

a rejection of claims 1-10 and 18 under 35 U.S.C. §103(a) as unpatentable over Lu et al. USP 6,365,517 (hereafter "Lu") in view of Tang et al. USP 6,462,931 (hereafter "Tang"); and

a rejection of claims 13, 15, 18-26 and 28-39 under 35 U.S.C. §103(a) as unpatentable over Tsu in view of Tang.

Such rejections of claims are traversed in respect of claims 1-26 and 28-39 as amended herein, and consideration of the patentable distinction of such amended claims is requested in light of the following remarks.

§102 Rejection of Claims 1-8, 11-12, 14 and 16-18 as anticipated by Tsu et al.

Claim 1 recites a microelectronic structure comprising, *inter alia*,

"at least one conductive barrier layer in contact with the layer of high dielectric constant material, wherein such

c conductive barrier layer comprises at least one material selected from the group consisting of Pt, Ir, IrO₂, Ir₂O₃, Ru, RuO₂, TaN, NbN, HfN, ZrN, WN, W₂N, TiAlN, TaSiN, NbAlN, and compatible combinations, mixtures and alloys thereof;

at least one metal layer in contact with the conductive barrier layer, wherein said metal layer comprises metal or metal alloy including a material selected from the group consisting of Cu and Al”

The Examiner has incorrectly rejected claim 1, and claims 2-8, 11-12, 14, 16 and 17 dependent thereunder, on §102(e) grounds based on Tsu. Specifically, the Examiner has mischaracterized Tsu at pages 2-3 of the May 19, 2003 Office Action, citing Tsu as disclosing, *inter alia*,

“at least one metal layer 20 in contact with the conductive barrier layer 22, wherein the metal layer 20 comprises metal or metal alloy including a material selected from the group consisting of Al, column 4 line 27, wherein at least one conductive barrier layer 22 is between at least one layer of high dielectric constant material 16 and at least one metal layer 20”

(Office Action, paragraph bridging pages 2 and 3)

In fact, layer 20 of Tsu is a silicide layer.

See Tsu at column 4, line 26 (“a silicide layer”); column 4, line 66 (“the silicide 20”); column 6, line 18 (“metal silicide 20”); column 6, line 24 (“metal silicide layer 20”); etc.

A silicide is a silicon compound.

Silicon is NOT a metal - silicon is a semiconductor.

Tsu clearly recognizes the distinction between metals *per se*, and silicides. The layer 20 is described by Tsu as being formed of various silicide materials, including “aluminum silicide (AlSi_x)” (column 4, line 27 of Tsu) and “metal alloy silicides” (column 4, line 29 of Tsu).

The nomenclature of the latter species (“metal alloy silicides”) shows that “metal alloy silicides” is different from “metal alloys” as such - the metal alloy silicide contains silicon as an element whereas “metal alloys” do not. Metal alloys are homogeneous mixtures or solid solutions of two or more metals.

Thus, applicants' claimed invention, requiring "at least one metal layer," is different from and non-suggested by the silicides of Tsu.

Further, Tsu teaches that silicides are essential to the disclosed integrated circuit capacitor that is taught by Tsu. See, for example, Tsu at column 2, lines 40-49:

"The resultant structure provides a novel integrated circuit capacitor. In one embodiment, this capacitor includes a semiconductor region, a silicide layer disposed on the semiconductor region, a conductive nitride layer disposed on the silicide layer, a dielectric layer disposed on the silicide layer, and a conductive layer disposed on the dielectric layer. A second embodiment capacitor has a first electrode which includes a semiconductor region and a conductive nitride layer disposed on the semiconductor region. The conductive nitride includes a metal silicide."

(Tsu, column 2, lines 40-49)

The next paragraph in Tsu (at column 2, lines 50-59) then emphasizes that such structure "has good oxidation resistance and high work function" and "better oxidation resistance and higher work function than pure metal electrodes."

Tsu therefore fails to teach or suggest the "at least one metal layer" that is required by applicants' claim 1, and (by virtue of their dependence from claim 1) claims 2-8, 11-12, 14 and 16-17, and there is no motivation in Tsu to vary the silicide layer in view of the performance benefits that are contended to result from the silicide layer-containing structure of Tsu.

Claim 1 and claims 2-8, 11-12, 14 and 16-17 are therefore patentably distinct over Tsu, and the withdrawal of the §102 (e) rejection of such claims based on Tsu is therefore respectfully requested.

§103 Rejection of Claims 1-10 and 18 Over Lu in View of Tang

Concerning the Examiner's rejection of claims 1-10 and 18 based on Lu in view of Tang, Lu has been cited for disclosing a microelectronic structure featuring a TiN barrier layer between a metal layer (of aluminum or copper) and a high dielectric constant material, with Tang being cited as a secondary reference as allegedly disclosing that TiAlN can be used to replace TiN, the Examiner referring to column 9, lines 26-29 of Tang and stating that

"it would have been obvious to one of ordinary skill in the art to replace barrier layer 2/22 of Lu with Tang conductive barrier, because such material substitution would have been considered a mere substitution of art-recognized equivalent values" (May 19, 2003 Office Action, page 4).

The Examiner's proposed basis for substituting TiAlN from Tang for TiN in Lu is illogical, as is apparent from the entire text of column 9, lines 26-29 of Tang, which the Examiner has cited in support of the rejection:

"In all of the preferred embodiments the silicon diffusion barrier alternatively could be made of TiAlN, W₂N, TaN, and so forth instead [sic - "instead" apparently intended] of the example TiN"

(emphasis added; Tang, column 9, lines 26-29)

This teaching has reference to the preceding disclosure in Tang, at column 8, lines 11-13:

"A conductive silicon diffusion barrier may be used on top of polysilicon-filled vias as TiN in FIG. 1a to avoid Ir-polysilicon interactions" (Tang, column 8, lines 11-13)

Thus, the teachings in Tang that the Examiner has cited as a basis for rejecting claims 1-10 and 18 are directed to *barriers between polysilicon and iridium*, and there is therefore no basis for modifying Lu in a way that would yield TiAlN between a high dielectric constant material layer and a copper or aluminum layer, as in applicants' claimed invention.

Further, Lu's teachings are specific to use of TiN, TiSi_xN_y or TiN_xB_y (see column 4, lines 32-36 of Lu) to form thin film diffusion barriers that are characterized by Lu as providing "lower resistivity" (column 4, line 46) and "low contact/via resistance" (column 4, lines 48-49), as well as "higher purity, density, and stability of the films formed by the instant invention" (column 2, lines 17-18) - all suggestive of superior electrical performance. There is therefore no reason why one would change the specific barrier layer compositions taught by Lu, and risk the loss of such performance advantages. Additionally, the barrier cited in Tang is disposed between polysilicon and iridium, neither of which is a high dielectric constant material. Accordingly, there is no combination of Lu and Tang that yields the structure of applicants' claimed invention.

In sum, there is no basis in Lu or Tang for changing Lu's thin film structure in the manner proposed by the Examiner, and no basis in the aggregate disclosures of such references for deriving the applicants' claimed invention.

Accordingly, the microelectronic structure of claims 1-10 and 18 is patentably distinguishable over Lu in view of Tang, and it therefore is requested that the rejection of claims 1-10 and 18 based on such cited references be withdrawn.

§103 Rejection of Claims 13, 15, 18-26 and 28-39 Over Tsu in View of Tang

The rejections of dependent claims 13, 15, 18-26 and 28-39 based on Tsu in view of Tang suffer from the same deficiencies as noted in the discussion hereinabove of Tsu as a §102(e) reference in relation to applicants' claim 1, from which each of claims 13, 15, 18-26 and 28-39 directly or indirectly depends.

Accordingly, all of the Examiner's proposed respective modifications of Tsu, e.g., to incorporate various barrier layer materials of Tang, to use multiple barrier layers as in Tang, etc., do not change the fact that the resulting structures in every case would still have the silicide layer of Tsu, and would lack the "at least one metal layer" required by applicants' broad claim 1, from which each of claims 13, 15, 18-26 and 28-39 directly or indirectly depends.

Claims 13, 15, 18-26 and 28-39 therefore are patentable over Tsu in view of Tang, and the withdrawal of the §103 (a) rejection of such claims based on Tsu in view of Tang is correspondingly requested.

Fee Payable for Rewriting of Claim 27 in Independent Form

Since the rewriting of claim 27 in independent form herein does not increase the total number of claims, nor the number of independent claims, beyond the numbers for which payment has previously been made in the application, no added claims fee is due or payable.

If it nonetheless is determined that any fee or amount is properly payable in connection with the entry of this response, the same hereby is authorized to be charged to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

AUG 20 2003
GROUP 2800

Conclusion

Claims 1-39 as amended herein and now pending in the application, are patentably distinguished over the cited references, and in form and condition for allowance. Issue of a Notice of Allowance for the application is therefore requested.

If any issues remain outstanding, incident to the formal allowance of the application, the Examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same, in order that this application may be allowed and passed to issue at an early date.

OFFICIAL

Respectfully submitted,



Steven J. Hultquist
Reg. No. 28,021
Attorney for Applicant(s)

INTELLECTUAL PROPERTY/
TECHNOLOGY LAW
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 2771-497 (7486)